Citation:

Yucel Sengun I, Karapinar M. Effectiveness of household natural sanitizers in the elimination of Salmonella typhimurium on rocket (Eruca sativa Miller) and spring onion (Allium cepa L.). *Int J Food Microbiol.* 2005 Feb 15; 98 (3): 319-323.

PubMed ID: 15698693

Study Design:

Non-randomized Trial

Class:

C - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To determine the sanitizing effect of lemon juice, vinegar and their mixture on *Salmonella typhimurium* inoculated on salad vegetables.

Inclusion Criteria:

Salad vegetables selected included rocket and spring onion, while sanitizers included fresh lemon juice, vinegar and their mixture.

Exclusion Criteria:

None specifically mentioned

Description of Study Protocol:

Recruitment

- Lemons were purchased from a local supermarket and washed with tap water
- Pasteurized grape vinegar was used directly (Fersan brand)
- Rocket and spring onion were purchased from a local supermarket.

Design

Non-randomized trial

Blinding used

Not applicable

Intervention

- Fresh whole rocket leaves and shredded spring onion samples were inoculated with *Salmonella typhimurium* suspensions to provide initial populations of approximately six and three log cfu per gram
- After inoculation, vegetables were treated with the lemon juice, vinegar and lemon juice-vinegar mixture test solutions for zero, 15, 30 and 60 minutes.

Statistical Analysis

- Three replicate trials were done for each duplicate experiment
- Data were subjected to analysis of variance and Duncan's multiple test to determine if significant differences in populations of *Salmonella typhimurium* existed between mean values.

Data Collection Summary:

Timing of Measurements

- Fresh whole rocket leaves and shredded spring onion samples were inoculated with *Salmonella typhimurium* suspensions to provide initial populations of approximately six and three log cfu per gram
- After inoculation, vegetables were treated with the test solutions for zero, 15, 30 and 60 minutes.

Dependent Variables

- *Salmonella typhimurium* on rocket and spring onion
- Pathogens were enumerated by using direct plating on Bismuth Sulphite Agar (BSA).

Independent Variables

- Fresh lemon juice
- Vinegar
- Fresh lemon juice and vinegar mixture (1:1).

Control Variables

Description of Actual Data Sample:

- ***Initial N****:* Three replicate trials were completed for each duplicate experiment
- ***Attrition (final N):*** As above
- ***Age****:* Not applicable
- ***Ethnicity****:* Not applicable
- ***Other relevant demographics****:* Not applicable
- ***Anthropometrics:*** Not applicable
- ***Location****:* Turkey.

Summary of Results:

Key Findings

- Treatment of rocket leaves with fresh lemon juice and vinegar caused a significant reduction ranging between 1.23 and 4.17 log cfu per gram and between 1.32 and 3.12 log cfu per gram, respectively, while the maximum reduction reached by using lemon juice-vinegar mixture (1:1) for 15 minutes, which reduced the number of pathogens to an undetectable level
- In the spring onion samples, lemon juice, vinegar and their mixture caused 0.87 to 2.93, 0.66 to 2.92 and 0.86 to 3.24 log cfu per gram reductions, respectively
- In spring onion samples, the maximum antimicrobial effect was observed at 60 minutes of exposure with the mixture solution ($P<0.05$)
- Overall, statistical analysis indicated that 15 minutes of exposure to all sanitizers used caused the highest antimicrobial effect on rocket leaves. The most effective preparation was found to be the lemon juice-vinegar mixture and there was no significant difference between lemon juice and vinegar in the elimination of viable S. typhimurium cells from rocket leaves ($P>0.05$).

Author Conclusion:

Results of our study and previous works showed that natural products such as fresh lemon juice, vinegar used alone or their mixture can be considered to be potential antimicrobial agent in preventing foodborne outbreaks related to fresh produce at household levels.

Reviewer Comments:

Small number of samples.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes

1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	???
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	???
2.2.	Were criteria applied equally to all study groups?	N/A
2.3.	Were health, demographics, and other characteristics of subjects described?	N/A
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A

4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes

	7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
	7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
	7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
	8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
	8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	N/A
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		???
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	No
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	Yes